The same arguments apply in a slightly modified form to the influence of the condenser on the amount of available work per pound of steam used by a steam turbine. But with steam turbines useful expansion can be obtained right down to the back pressure, and therefore high vacua can be used economically. For this reason condensers have undergone considerable developments in recent years, giving higher vacua and greater rates of condensation than formerly.

A certain amount of air or incondensable gases finds its way into the condenser under ordinary conditions of operation, and this necessitates an " air-pump " to withdraw this air as fast as it enters the condenser; otherwise the condenser would get full of air, the pressure would eventually rise to atmospheric pressure, and the condenser would then cease to be usefully operative. With reciprocating engines the air-pump is generally used also to extract the water as well as the air, in which case it is called a " wet " air-pump. In other cases the air-pump deals with the air only, and is then called a " dry " air-pump, a separate pump or its equivalent being used to extract the water.

The greater portion of the air which enters a condenser is due to leakage through the low-pressure piston rod or turbine glands, badly made exhaust-pipe joints, and porous castings. The feed water entering the boiler usually carries a small amount of air in solution, and this also eventually finds its way into the condenser with the steam. When the cooling or condensing water is injected into the condenser and comes into direct contact with the steam, as in jet condensers, the greater portion of the air which is in solution in this water comes out of solution in the .condenser under the influence of the heating and the low pressure. Under ordinary circumstances, however, the leakage of air is a more serious factor than the air which comes out of solution from the water.

Every endeavour should be made to reduce the leakage of air into the condenser. Not only does the presence of air interfere with the condensation of the steam, but it also tends to increase the total pressure in the condenser, or, in other words, it tends to reduce the

vacuum. When air and water-vapour are mixed together the total pressure exerted by the mixture is the sum of the pressures of the constituents, each exerted as if it occupied the space alone, and as if the other were not present. This pressure due to any constituent of a mixture is sometimes called its " partial pressure ". Now the partial pressure of saturated steam is dependent only upon its temperature, whereas the partial pressure of air depends upon the weight of air present as well as upon the temperature. For example, if the total pressure at the air-pump suction is 2 Ib. per square inch absolute, and the temperature of the mixture is 100° F., reference to steam tables shows that the pressure of steam at this temperature is 0-94 Ib. per square inch. Therefore the partial air pressure is:

2 — 0-94 = i-06 Ib. per square inch.

Again, the volume of i Ib. saturated steam at 100° F. is

about 350 c. ft.,